WHAT WE CLAIM IS:

1. A reflection type diffuse hologram characterized by reflecting, and diffracting light incident thereon at an angle with respect to a normal direction while it is diffused within a desired angle range.

2. The reflection type diffuse hologram of claim 1, characterized in that an angle of diffusion lies within a range of 10° to 35°.

3. A reflection type diffuse hologram, characterized by having been formed by allowing scattered light that diffuses within a desired angle range, and parallel light to strike on both surfaces of a volume hologram-recording photosensitive material, and interfere therein.

4. The reflection type diffuse hologram of any one of claim 1 to 3, characterized in that an image has simultaneously been recorded in a reconstructible fashion.

5. The reflection type diffuse hologram of any one of claim 1 to 3, characterized by being located on a backlight side of a liquid crystal display device for diffuse illumination purposes.

6. A method for fabricating a reflection type diffuse hologram characterized in that a transmission type diffusing plate having a diffusion angle characteristic within a desired angle range is located in close contact with, or in proximity to, a volume hologram-recording photosensitive material, and two light beams are allowed to strike on front and back sides of the combined diffusing plate and photosensitive material for interference recording.

7. The method for fabricating a reflecting type diffuse hologram according to claim 6, characterized in that the transmission type diffusing plate is a diffusing plate of a 20% to 60% haze.

8. The method for fabricating a reflecting type diffuse hologram according to claim 6, characterized in that the transmission type diffusing plate is an array of microlenses.

9. The method for fabricating a reflecting type diffuse hologram according to claim 6, characterized in that the transmission type diffusing plate is a lenticular screen.

10. A reflection type of direct-view color display device using a hologram color filter, characterized by comprising a hologram color filter composed of an array of element light-collecting holograms,

each of said element light-collecting holograms comprising a hologram color filter for subjecting white light incident thereon at a given angle with respect to a normal line of a hologram-recorded surface to wavelength dispersion in a direction substantially along said hologram-recorded surface for spectral diffraction, a reflection type hologram located in the vicinity of a light-collection surface thereof, and a transmission type spatial light modulator located between said hologram color filter and said reflection type hologram.

11. The reflection type of direct-view color display device using a hologram color filter according to claim 10, characterized in that said reflection type hologram has

interference fringes recorded in the vicinity of a position on which said white light strikes while said white light is separated into each spectral component of each color, said interference fringes reflecting light of wavelength of each color in an identical direction.

12. The reflection type of direct-view color display device using a hologram color filter according to claim 11, characterized in that said reflection type hologram has diffusibility.

13. The reflection type of direct-view color display device using a hologram color filter according to any one of claims 10 to 12, characterized in that said transmission type spatial light modulator comprises a liquid crystal display element.

14. A reflection type color display device, characterized by comprising a transmission type spatial light modulator comprising a collection of pixels, and having a controllable transmittance per pixel, and a reflection type hologram color filter located on a back side of said modulator.

15. The reflection type color display device of claim 14, characterized in that said reflection type hologram color filter comprises periodically arranged volume hologram elements varying in reflection, and diffraction wavelength for each position of pixels in said transmission type spatial light modulator.

16. The reflection type color display device of claim 15, characterized in that said reflection type hologram color filter has diffusibililty.

17. The reflection type color display device of any one of claims 14 to 16, characterized in that said reflection type hologram color filter has an absorption layer located on a back surface thereof.

18. The reflection type color display device of any one of claims 14 to 16, characterized in that said reflection type hologram color filter is provided on a back surface thereof with an absorption type color filter, which is provided on a back surface thereof with a backlight source, so that color information is interchangeable when said backlight source is turned on, said color information being displayed on each pixel in said transmission type spatial light modulator.

19. The reflection type color display device of any one of claims 14 to 17, characterized in that said transmission type spatial light modulator comprises a liquid crystal display element.

20. The reflection type color display device of any one of claims 14 to 17, characterized in that said transmission type spatial light modulator comprises a polymer-dispersed type liquid crystal display element.

21. A hologram-recorded medium which is an imagewise or other pattern-recorded medium comprising a collection of pixels, characterized in that any one of a plurality of volume type diffraction gratings comprising volume holograms

and differing from each other is assigned to at least a part of said pixels.

22. The hologram-recorded medium of claim 21, characterized in that a plurality of volume type diffraction gratings comprising said volume holograms and differing from each other include at least three volume type diffraction gratings which are identical in orientation of grating surface with each other but different in grating spacing from each other.

23. The hologram-recorded medium of claim 21 or 22, characterized in that at least two of a plurality of mutually different volume type diffraction gratings are multi-recorded in at least a part of the pixels.

24. The hologram-recorded medium of any one of claims 21 to 23, characterized in that a volume type diffraction grating that expresses red, a volume type diffraction grating that expresses green, and a volume type diffraction grating that expresses blue are assigned to three dot areas into which at least a part of the pixels is divided, or to three adjoining pixels, so that color tone or gradation is controlled by varying a dot percent occupied by said volume type diffraction gratings, or a diffraction efficiency ratio between said volume type diffraction gratings.

25. The hologram-recorded medium of any one of claims 21 to 24, characterized by having a reflecting layer on a back surface thereof.

26. The hologram-recorded medium of any one of claims 21 to 25, characterized in that each pixel has diffusibility.

27. The hologram-recorded medium of any one of claims 21 to 26, characterized by being used as a reflection type hologram color filter.

28. A method of fabricating a hologram-recorded medium which is an imagewise or other pattern-recorded medium comprising a collection of pixels, and in which any one of a plurality of volume type diffraction gratings comprising volume holograms and differing from each other is assigned to at least a part of said pixels, characterized by stacking a volume hologram photosensitive material on a reflection type relief hologram, and striking reconstructing illumination light of given wavelength on said reflection type relief hologram through said volume hologram photosensitive material, so that interference fringes produced by interference of light diffracted from said reflection type relief hologram and the incident light are recorded in said volume hologram photosensitive material.

29. A method of fabricating a hologram-recorded medium which is an imagewise or other pattern-recorded medium comprising a collection of pixels, and in which any one of a plurality of volume type diffraction gratings comprising volume holograms and differing from each other is assigned to at least a part of said pixels, characterized by stacking a volume hologram photosensitive material on a transmission type hologram, and striking reconstructing illumination light of given wavelength on a side of said transmission type hologram that is not opposite to said volume hologram photosensitive material, so that interference fringes

produced by interference of light diffracted from said transmission type hologram and reference light incident on said volume hologram photosensitive material are recorded in said volume hologram photosensitive material.

30. A method of fabricating a hologram-recorded medium which is an imagewise or other pattern-recorded medium comprising a collection of pixels, and in which any one of a plurality of volume type diffraction gratings comprising volume holograms and differing from each other is assigned to at least a part of said pixels, characterized by stacking a volume hologram photosensitive material on a transmission type hologram, and striking reconstructing illumination light of given wavelength on a side of said transmission type hologram that is not opposite to said volume hologram photosensitive material, so that interference fringes produced by interference of light diffracted from said transmission type hologram and zero-order transmitted light are recorded in said volume hologram photosensitive material, followed by provision of a reflecting layer on a back side of said volume hologram photosensitive material.

31. A method of fabricating a hologram-recorded medium which is an imagewise or other pattern-recorded medium comprising a collection of pixels, and in which any one of a plurality of volume type diffraction gratings comprising volume holograms and differing from each other is assigned to at least a part of said pixels, characterized by locating a mask plate having an opening pattern on one side of a volume hologram photosensitive material and a reflecting mirror on

another side of said volume hologram photosensitive material, said reflecting mirror having a specific angle of inclination with respect to said volume hologram photosensitive material, and striking a light beam on said volume hologram photosensitive material through said opening pattern in said mask plate, so that interference fringes produced by interference of the incident light and light reflected from said reflecting mirror are recorded in said volume hologram photosensitive material.

32. A method of fabricating a hologram-recorded medium which is an imagewise or other pattern-recorded medium comprising a collection of pixels, and in which any one of a plurality of volume type diffraction gratings comprising volume holograms and differing from each other is assigned to at least a part of said pixels, characterized by locating a mask plate having an opening pattern on one side of a volume hologram photosensitive material and an off-axis reflection type hologram on another side of said volume hologram photosensitive material, said off-axis reflection type hologram diffracting a light beam incident at a given angle of incidence in an opposite direction at a specific angle with respect thereto, and striking a light beam on said volume hologram photosensitive material through said opening pattern in said mask plate, so that interference fringes produced by interference of the incident light and light diffracted from said off-axis reflection type hologram are recorded in said volume hologram photosensitive material.

33. A method of fabricating a hologram-recorded medium which is an imagewise or other pattern-recorded medium comprising a collection of pixels, and in which any one of a plurality of volume type diffraction gratings comprising volume holograms and differing from each other is assigned to at least a part of said pixels, characterized by locating a composite reflector comprising a collection of micro-mirror surfaces varying in reflection direction per position on a back side of a volume hologram photosensitive material, and striking a light beam on a surface side of said volume hologram photosensitive material, so that interference fringes produced by interference of the incident light and light reflected from said composite reflector are recorded in said volume hologram photosensitive material.

34. A method of fabricating a hologram-recorded medium which is an imagewise or other pattern-recorded medium comprising a collection of pixels, and in which any one of a plurality of volume type diffraction gratings comprising volume holograms and differing from each other is assigned to at least a part of said pixels, characterized by striking two coherent thin light beams at a position of each of pixels in a volume hologram photo-sensitive material while said beams intersect at a relative angle corresponding to said position, thereby recording in said volume hologram photosensitive material interference fringes having an inclination and a pitch depending on said pixel position.

35. A hologram color display medium which is a hologram color display medium having interference fringes of light

recorded in a thickness direction of a film, characterized by using two swelling films each containing a penetrating monomer or oligomer that is diffusible externally from a surface of said film, said penetrating monomer or oligomer being deactivated according to a given deactivation pattern, so that said hologram is swollen by said penetrating monomer or oligomer diffused from both surfaces of said hologram at different degrees of swelling depending on position.

36. The hologram color display medium of claim 35, characterized in that said two swelling films are brought into close contact with both surfaces of said hologram, so that a two-dimensional diffraction pattern of two or more colors is obtained by a combination of the deactivation pattern of one swelling film with that of another swelling film.

37. The hologram color display medium of claim 35 or 36, characterized in that a color image is expressed by means of a collection of color display micro-units, each comprising a combination of two or more micro-pixels displaying two or more different colors, and a dot percent of dots in each color display micro-unit is varied to express each color display micro-unit in any desired color by additive color mixing.

38. The hologram color display medium of claim 37, characterized in that interference fringes recorded in said hologram is designed such that diffraction efficiency changes depending on positions of said color display micro-units.

39. The hologram color display medium of claim 37, characterized in that said hologram itself or a diffraction-side surface thereof is designed such that absorptance changes depending on positions of said color display micro-units.

40. The hologram color display medium of any one of claims 35 to 39, characterized in that said hologram is a volume phase type hologram.

41. The hologram color display medium of claim 40, characterized in that said hologram is a hologram recorded in a photopolymer.

42. The hologram color display device of any one of claims 35 to 41, characterized by having diffusibility.

43. The hologram color display medium of any one of claims 35 to 42, characterized by being used in the form of a reflection type hologram color filter.

44. A method for fabricating a hologram color display medium including a hologram having interference fringes of light recorded in a thickness direction of a film, wherein two swelling films each containing a penetrating monomer or oligomer that is diffusible externally from a surface of said film, said penetrating monomer or oligomer being deactivated according to a given deactivation pattern, are used so that said hologram is swollen by said penetrating monomer or oligomer diffused from both surfaces of said hologram at different degrees of swelling depending on position, characterized in that

before or after the close contact of the two swelling films, in which the penetrating monomer or oligomer contained in that position is deactivated by irradiation of a given or more quantity of light, with both surfaces of said hologram, said two swelling films are irradiated according to said given deactivation pattern with a given or more quantity of light, and

said hologram with the thus deactivated swelling films brought into close contact with both surfaces thereof is heated, thereby diffusing said penetrating monomer or oligomer from active areas of said swelling films into said hologram.

45. A method for fabricating a hologram color display medium including a hologram having interference fringes of light recorded in a thickness direction of a film, wherein two swelling films each containing a penetrating monomer or oligomer that is diffusible externally from a surface of said film, said penetrating monomer or oligomer being deactivated according to a given deactivation pattern, are used so that said hologram is swollen by said penetrating monomer or oligomer diffused from both surfaces of said hologram at different degrees of swelling depending on position, characterized in that

before or after the close contact of one swelling film, in which the penetrating monomer or oligomer contained in that position is deactivated by irradiation of a given or more quantity of light, with one surface of said hologram, said one swelling film is irradiated according to said given

deactivation pattern with a given or more quantity of light,

said hologram with the thus deactivated swelling film brought into close contact with said one surface is heated, thereby diffusing said penetrating monomer or oligomer from an active area of said one swelling film into said hologram,

before or after the close contact of another swelling film, in which the penetrating monomer or oligomer contained in that position is deactivated by irradiation of a given or more quantity of light, with another surface of said hologram, said another swelling film is irradiated according to said given deactivation pattern with a given or more quantity of light, and

said hologram with the thus deactivated swelling film brought into close contact with said another surface is again heated, thereby diffusing said penetrating monomer or oligomer from an active area of said another swelling film into said hologram.

46. The method for fabricating a hologram color display medium according to claim 44 or 45, characterized in that said hologram is a volume phase type hologram.

47. The method for fabricating a hologram color display medium according to claim 46, characterized in that said hologram is a hologram recorded in a photopolymer.

48. A multicolor hologram display unit in which volume holograms that diffract light of at least tow different wavelengths are multi-recorded or superposed one upon another, characterized by including a halftone color pattern area comprising a dot area with two holograms of said volume

holograms multi-recorded or superposed one upon another, and a background area for each other of said two holograms recorded between dots.

49. A multicolor hologram display unit in which volume holograms that diffract light of at least two different wavelengths are multi-recorded or superposed one upon another, characterized by including a halftone color pattern area wherein, in a micro-dot portion in an area having one hologram of said volume holograms recorded all over a surface thereof, there is multi-recorded or superposed another hologram.

50. The multicolor hologram display unit of claim 48 or 49, characterized in that in addition to said halftone color pattern area, there are an original color pattern area with the respective holograms independently recorded therein, and another halftone color pattern in which two or more different holograms are multi-recorded or superposed all over a surface thereof.

51. The multicolor hologram display unit of any one of claims 48 to 50, characterized by including an area having a different dot percent.

52. The multicolor hologram display unit of any one of claims 48 to 51, characterized in that said hologram comprises a reflection scattering type hologram.

53. A multicolor hologram display unit comprising volume holograms multi-recorded therein, said volume holograms diffracting light of at least two different wavelengths, characterized by further comprising a color

tuning film containing a penetrating monomer or oligomer that is diffusible from a surface thereof to an outside thereof, said penetrating monomer or oligomer being deactivated according to a given deactivation pattern, so that said monomer or oligomer is diffused from said color tuning film, whereby a portion of said volume holograms in no alignment with said deactivated pattern is swollen to diffract light of a wavelength that is different from a wavelength that is diffracted by a portion of said volume holograms in alignment with said deactivated pattern.

54. The multicolor hologram display unit of claim 53, characterized in that said multi-recorded volume holograms are recorded all over a surface thereof, with said deactivation pattern comprising dots.

55. The multicolor volume hologram display unit of claim 54, characterized by being used as a hologram reflecting and scattering plate for liquid crystal display apparatus.

56. The multicolor volume hologram display unit of claim 54, characterized by including an area having a different dot percent.

57. The multicolor volume hologram display unit of claim 53, characterized in that said multi-recorded volume holograms are each recorded in a separate pattern area.

58. The multicolor volume hologram display unit of claim 57, characterized in that an area swollen by said color tuning film and an unswollen area provide dots wherein red, green, and blue colors are reconstructible.

59. The multicolor volume hologram display unit of claim 58, characterized by including an area having a different dot area.

60. The multicolor volume hologram display unit of any one of claims 53 to 59, characterized in that said color tuning film is integrally provided thereon.

61. The multicolor volume hologram display unit of any one of claims 48 to 60, characterized by being used as a reflection hologram color filter.